

REMARKS

The Office has maintained the rejection of claims 9, 11, 13 and 15 under 35 U.S.C. 112, second paragraph, as being indefinite and the rejections of the claims under 35 U.S.C. § 103(a) as being obvious over Hatazaki et al., US 2001/0038949 ("Hatazaki") and over Hatazaki in view of Kameda et al., US 6,632,569 ("Kameda") that were made in the Action of January 26, 2007.

Claims 9, 11, 13 and 15 have been amended to avoid the 35 U.S.C. § 112 rejection.

Regarding the rejections under 35 U.S.C. § 103(a), applicants note that claim 1 of the present application is directed to a nonaqueous electrolyte secondary battery comprising a positive electrode including a positive electrode active material, a negative electrode including a carbon material as a negative electrode active material and a nonaqueous electrolyte including a solvent and a solute, wherein sulfolane is contained as a solvent in the nonaqueous electrolyte in an amount of 20 ~ 45 % by volume, on the basis of the total volume of the solvent, and vinyl ethylene carbonate and vinylene carbonate or a derivative of vinylene carbonate are added to the nonaqueous electrolyte.

Hatazaki discloses a nonaqueous electrolyte secondary battery comprising a positive electrode; a negative electrode: a nonaqueous

electrolyte including a solvent and a solute; and a specific surface active agent added to the electrolyte. Hatazaki discloses that at least one of a carbonic acid ester type additive and a sulfur compound type additive can be further added to the nonaqueous electrolyte in an amount of 0.1 to 10 parts by weight per 100 parts by weight of the nonaqueous electrolyte.

In the response filed April 26, 2007, to the first Action applicants argued that a person of ordinary skill in the art would not have been motivated to modify the battery of Hatazaki to increase the amount of sulfolane to an amount of more than 10 parts by weight (as required by the claims of the application) because Hatazaki discloses the use of sulfolane only as an "additive" to a nonaqueous solvent and discloses that if the additive (i.e., sulfolane) is used in an amount of more than 10 parts by weight, discharge characteristics are deteriorated. Applicants noted that the amount of sulfolane of 20 ~ 45 volume %, on the basis of the total volume of the solvent, as now recited in claim 1 of the present application is significantly greater than the upper limit of 10 parts by weight of sulfolane as described in Hatazaki because the specific gravity of sulfolane is not large.

In response to these arguments, the Office has correctly noted that the amount of the at least one additive is 0.1-10 parts by

weight of the electrolyte and not 0.1-10 parts by weight of the solvent.

Applicants note that because the specific gravity of sulfolane is not large, 0.1 to 10 parts by weight of sulfolane per 100 parts by weight of the nonaqueous electrolyte disclosed in Hatazaki corresponds closely to an amount of 0.1-10% by volume based on the volume of solvent of the nonaqueous electrolyte. This is demonstrated on the basis of the following calculations.

In Examples 1, 2 and 3 of Hatazaki, the use of an electrolyte of 1 mol/l of LiPF_6 in a mixed solvent containing ethylene carbonate (EC) and ethylmethyl carbonate (EMC) in a volume ratio of 1:3 is described. (These examples include Battery No. 31 in which sulfolane is used as an additive in an amount of 2 parts by weight). The specific gravity of this electrolyte is 1.237 g/cm³, which is obtained using a molecular weight of LiPF_6 of 151.9, a specific gravity of EC of 1.322, and a specific gravity of EMC of 1.007. For 1 l of the electrolyte, 250 ml of EC and 750 ml of EMC are mixed (EC/EMC (1/3)). The weight of EC is about 330 g (250 ml x 1.322), and that of EMC is about 755 g (750 ml x 1.007). The electrolyte includes LiPF_6 at a concentration of 1 mol/l, i.e., 151.9 g/l. Therefore, the weight of 1 l of the electrolyte is about

1,237 g (330 g + 755 g + 151.9 g), and, therefore, the specific gravity of the electrolyte is 1.237 g/cm³.

If 0.1 - 10 % by weight of sulfolane (SL) is added to 1 l of the electrolyte (i.e., 1,237 g of electrolyte), the weight of the added SL is from 1.237 g to 123.7 g. The volume of 1.237 g to 123.7 g of the SL is 1.237 g/1.254 to 123.7 g/1.254 = 0.986 ml to 98.6 ml (where 1.254 is the specific gravity of SL). 0.986 ml to 98.6 ml of SL is equivalent to 0.099 - 9.9 % by volume ((0.986 - 98.6 ml)/1,000 x 100)).

With respect to the electrolyte of Battery 42 in Example 4 of Hatazaki, which electrolyte appears to be the closest electrolyte to the preferred electrolyte of the present invention, the volume % equivalent to 0.1 - 10 % by weight of SL can be calculated in the same way as explained above.

The specific gravity of the electrolyte used for Battery 42 is 1.289 g/cm³ which is obtained using a molecular weight of LiPF₆ of 151.9, a specific gravity of GBL of 1.125, and a specific gravity of VC of 1.355.

If 0.1 - 10 % by weight of SL is added to 1 l of the electrolyte (i.e., 1,289 g of electrolyte), the weight of the added SL is from 1.289 g to 128.9 g. The volume of 0.1 - 10 % by weight of the SL is 1.289 g/1.254 to 128.9 g/1.254 = 1.02 ml - 102 ml

(where 1.254 is the specific gravity of SL). 1.02 ml - 102 ml of SL is equivalent to 0.10 - 10.2 % by volume of the electrolyte.

The undersigned believes that the volume % of sulfolane in other combinations of solvents useful as the electrolyte in Hatazaki will not be materially different from the amount of sulfolane in parts by weight.

As noted above and as explained in the response to the first Action, a person of ordinary skill in the art would not have been motivated to modify the battery of Hatazaki to increase the amount of sulfolane and the person of ordinary skill in the art could not have reasonably predicted that such modification would have been successful.

First, as noted above, sulfolane is disclosed only as an "additive" to a nonaqueous solvent and not as a nonaqueous solvent, itself, in Hatazaki. The term "additive" is believe to suggest something that is added to something else in a relatively minor amount.

Second, Hatazaki discloses that if either or both of these additives are used in an amount of more than 10 parts by weight, discharge characteristics are deteriorated. Specifically, paragraph [0049] of Hatazaki, describes that "if the amount thereof (SL) is more than 10 parts by weight, the coating film formed on

the electrode becomes too thick, thereby deteriorating the discharge characteristics."

The description that the battery properties are deteriorated if the additives are used in an amount of more than 10 parts by weight "teaches away" from increasing the amount of sulfolane to an amount equivalent to the amount of 20 ~ 45 volume %, on the basis of the total volume of the solvent, required by the claims of the present application. Obviousness requires that the prior art as a whole provide a teaching, suggestion or motive to modify the art as proposed by the Office. A reference that teaches away from a given combination negates a motivation to modify the prior art to meet the claimed invention. *See, e.g., Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 [77 USPQ2d 1865] (Fed. Cir. 2006). "A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *In re Kahn*, 441 F.3d at 990 (quoting *In re Gurley*, 27 F.3d 551, 553 [31 USPQ2d 1130] (Fed. Cir. 1994)) (internal quotation marks omitted).

The court decisions cited by the Office are not applicable to a situation as in the present application where the prior art, i.e., Hatazaki, teaches away from the claimed invention.

Applicants note that the present invention has been developed focusing on the high boiling point of sulfolane, i.e., 287 °C, which is higher than that of other solvents. When sulfolane is added to an electrolyte of a secondary battery in a range of 20 -45 % by volume, it has been found that it contributes to a significant improvement in the safety of the battery.

Hatazaki does not disclose or suggest anything relating to improving the safety of a secondary battery by the addition of sulfolane and the amount of sulfolane used as an additive in Hatazaki is significantly less than that of the present invention. Therefore, no contribution to an improvement in safety can be expected in Hatazaki.

The present invention has been completed by the use of 20 - 45 % by volume of sulfolane in the electrolyte to improve safety. A problem of lack of compatibility of sulfolane with a negative electrode made of a carbon material has been solved by the addition of vinyl ethylene carbonate and vinylene carbonate to the electrolyte which improves charge and discharge characteristics. Thus, the present invention is different and non-obvious from Hatazaki.

Removal of the 35 U.S.C. § 103(a) rejection of claims 1, 3, 5, 7, 9, 11, 13 and 15 is believed to be in order and is respectfully requested.

PATENT APPLN. NO. 10/809,842
RESPONSE UNDER 37 C.F.R. §1.111

**PATENT
NON-FINAL**

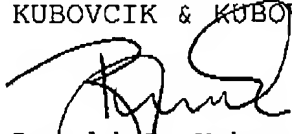
Regarding the rejection of claims 17, 19 and 20, this rejection depends on the propriety of the rejection of the claims, i.e., claims 1, 3 and 5, on which claims 17, 19 and 20, respectively, depend. Claims 1, 3 and 5 have been shown to be patentable. Therefore, claims 17, 19 and 20 are *prima facie* patentable.

The foregoing is believed to be a complete and proper response to the Office Action dated July 17, 2007.

In the event that this paper is not considered to be timely filed, applicants hereby petition for an appropriate extension of time. The fee for any such extension can be charged to Deposit Account No. 111833.

In the event any additional fees are required, please also charge Deposit Account No. 111833.

Respectfully submitted,
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